NOVEMBER 6.

The President, Dr. LEIDY, in the chair.

Forty-four persons present.

A paper, entitled "On the Value of the 'Nearctic' as one of the Primary Zoological Regions. Replies to Criticisms by Mr. Alfred Russel Wallace and Prof. Theodore Gill," by Professor Angelo Heilprin, was presented for publication.

On Visual Organs in Solen.—Dr. BENJAMIN SHARP called attention to a remarkably primitive form of visual organ that he had discovered in the siphon of *Solen ensis* and *S. vagina* (the common "razor-shell").

His attention was directed to the probable possession of visual organs by observing a number of these animals which were exposed in large basins for sale at Naples. A shadow cast by his hand caused the extended siphons of the specimens on which the shadow fell, instantly to retract, while those not in the shadow remained extended. Repeating this experiment at the Zoological Station at Naples, and being fully convinced that the retraction was due to the shadow and not to a slight jar which might have been the cause; he was led to examine the siphon more closely, and he also made a series of vertical sections for the purpose of very minute study.

When the siphon of a large *Solen* is cut open and examined, a number of fine blackish brown lines or fine grooves are seen. These are situated between and at the base of the short tentacular processes of the external edge of the siphon. As many as fifty of these little grooves were found to be present in some specimens, and some of them were from 1 to 1·5 mm. in length.

When a vertical section is examined these pigmented grooves are distinctly seen, and the cells of which they are composed are very different from the ordinary epithelial cells which cover the more pigmented parts. These latter cells are ordinary columnar epithelial cells with a large nucleus which is situated near the *tunica* on which it rests. The pigmented cells are from one-third to one-half longer than those just described, and consist of three distinct parts. The upper part, or that part farthest from the *tunica*, appears perfectly transparent and takes up about one-ninth or one-tenth of the total length of the cell; this part is not at all affected with the coloring matter which was used in coloring the whole. The second part of the cell is deeply pigmented and consequently opaque; it is filled with a dark brown or almost black granulated pigment; this takes up about one-half of the length of the cell. Below this is the third part of this cell, consisting of

a clear mass, which takes a slight tinge when colored; this is probably the most active part of the cell; in this is imbedded the large oval nucleus. This nucleus is sharply demarcated and is filled with a granulated matter which takes a dark color in borax carmine, as do, indeed, the nuclei of all the epidermal cells.

These *retinal cells*, if they may be so called, are similar to those described by P. Fraisse in 1881 (Zeitschr. f. wiss. Zool., Bd. xxv), in the very primitive eye of *Patella cœrulea*, the principal difference being that in *Patella* the transparent part at the top of the cell seems to be a little more extensive. This eye of *Patella* is open, being merely an invaginated part of the epidermis, and has no lense. In *Haliotis tuberculata* we find an open eye also, but with the addition of a very primitive lense. The next higher grade of eye seems to be that of *Fissurella rosea*, in which the eye is closed and possesses also a lense; now in these two latter forms, where we find a lense present, the retinal cells do not possess the transparent ends as we find in *Patella* and *Solen*, but the pigment fills the upper part of the cell quite to the top. This would indicate, he thinks, that the transparent part took the place of a lense.

No special nerve-fibres could be detected passing to these pigmented grooves. Nerves passing to the eye of *Patella* were also wanting, while, on the other hand, distinct veins were found passing to the eye of *Haliotis* and *Fissurella*.

He further stated that this power of distinguishing a shadow would be of great use to the animal in the struggle for existence. The *Solen* lies buried perpendicularly in the sand and allows the siphon to project a little above the surface. This projecting part would, probably, frequently be bitten off by fishes, were it not for the fact that the shadow of the enemy would give warning, so that the siphon could be withdrawn in time to save it from destruction.

Notes on Glaciers in Alaska.—Mr. THOMAS MEEHAN remarked that on his recent visit to Alaska he noted that the numerous icebergs coursing down Glacier Bay, always pursued their swift downward course towards the Pacific Ocean quite independently of the rising or falling of the tide. On reflection it was evident that this might be due to the greater density of the cold glacier water pressing on towards the lighter water in the Japan Sea, which set its force against the Alaskan shores. It was, indeed, incorrect to speak of a warm current flowing northwards in any active sense. Warm water never flowed or circulated because it was warm, but it flowed under the simple laws of gravitation—the heavier body pushing the lighter out of its place, and the lighter then being drawn backwards to the vacuum caused by the movement of the weightier volume. The flow of a warm current in the atmosphere or in the water must, therefore, be taken in a passive and not in an active sense; and it was, therefore, to the

immense ice-fields of Alaska themselves that we have to look for the singularly moderate climate of southeastern Alaska, rather than to the mere action of heated water alone. They furnish the heavy power which draws the warm current to its shores. With the disappearance of these huge glaciers, or the diversion of the immense volume of cold water to another channel, the cold of this portion of Alaska would probably be as intense as that experienced along its northern coast. The distinction was one of vast importance, and he ventured an opinion that much of the disappointment often experienced in Arctic navigation arose from overlooking it, and in regarding the warm current as the active agent in circulation.

In examining the Davidson, the Muir, and other glaciers, it also occurred to him that there were active agencies at work, overlooked by those who had made specialties of glacial study. Beneath the Muir glacier, which was said by various authorities to be about four hundred miles long, a large volume of water was flowing in a rapid torrent—this volume, on a carefully considered guess, being about one hundred feet wide with an average depth of four feet. According to information from a white man who had long lived with the Indians of this section, this subglacial river was flowing in about the same volume, summer and winter. The mouth of this glacier hung over into the sea, and formed icebergs in three different modes. Sometimes the edge of the glacier would, in its thinner sections, float over and be lifted off by the rise and fall of the tide; at other times huge masses would break off by their own weight; and at other times the upper edges, which, by the action of running surface water, would be worn into all sorts of rough forms, would topple over, rubbing their faces against the more solid ice, and making a sound which reverberated through the ranges of hills like peals of artillery, and which could be heard many miles away. There were thousands of smaller icebergs floating down Glacier Bay, the most of these evidently formed by the latter mode. It was not safe for the vessel on which he made the visit to approach nearer than a quarter of a mile to the face of this glacier, where it anchored for a day in order to make the examination; but it was near enough, especially with the aid of the ship's boats and good field-glasses, to make excellent observations. So far as could be ascertained through occasional deep fissures, no water came out from under the face of the glacier to the ocean. The mass of ice was apparently lying flat on a bed of rock, the ice occupying a width of something less than two miles, and estimated to be about 300 feet thick on an average of its whole width. This would, of course, obstruct the run of water directly to the ocean, and thus we had the lateral flow which diverged from the glacier's bed about four miles from its mouth. The Davidson glacier, in Pyramid Harbor, had retreated from the ocean, and by comparing facts observed in tracing a portion of its bed with what was seen in connection with this

torrent from the Muir glacier, it was evident that during a glacier's existence the underflowing river might often become dammed, and the torrent diverted, carrying glacial deposits to sections of country long distances away from the track of the glacier, and through portions of country over which glaciers had never flowed. And there might be immense glacial deposits left by a glacier constantly retreating, and after many subsequent years, by the diversion of the glacial river, a new channel and new remains may be deposited through the mass, even by another distant and distinct glacier. This was actually the case in this instance. This stream had torn its way through immense hills of glacial deposits, many hundreds of feet deep, exposing to view the trunks, still standing erect, of a buried forest, though not a stick of forest-growth, except a few alders and willows, could be seen anywhere in the vicinity, as far as the eye could reach, and suggesting that the original deposit was not made by the existing glacier, the waters of which now tore their way through the huge hills.

The question would now arise as to the source of the water supplying the subglacial river-bed. It would be well to carry some ascertained facts along with us in this examination. An iceberg of more than usual dimensions had got aground in Glacier Bay, and, having one good, fair face, it was found by careful soundings that the vessel could be placed close alongside. At seven and a half fathoms, we were able to hitch on to the great block, the sides of which projected far above our deck. The surface of this berg exhibited, in a small way, all the features of a tract of land: lakes, rapids, waterfalls, hills and valleys; in some places, earth and stones. To-day the course of a water-channel might be in one direction, till a falling piece of ice or earth would block it up, when a source would be opened for a new direction, and the little streams, once started, would form in a short space of time wide and deep chasms. A piece of rock, by its dark color attracting the sun's rays, would sink deep into the berg, while earth, porous and non-conducting, would prevent melting; and thus we would have mounds on the berg where the surroundings, clear of earth, would be melted away. The action of the sun on melting portions of the berg was interesting. The thermometer was but 42°; yet on any side where the sun fell, even at this low temperature, the little streams and rivulets were coursing their way to the great ocean around. But on the northern slopes, there were barely any streams, except such as originated on the sunnier sides. In fact, it was demonstrated that wherever the sun struck on ice, even at a low temperature, the deposition of water occurred. What he had carefully noted on this iceberg he had before noted on high mountain peaks: there would be always some melting from the face of a snow-bank, no matter how low the temperature, where the sun shone fairly on it, and the water would sink to the bottom of this mass. On this iceberg there were clefts and rifts and wells furrowed by

the gathering together of melted water into small pools or lakes, or over where dark stones had sunk by the agency of the sun's warmth; but in no case had the holes or cavities penetrated wholly through the iceberg, except on its thinnest outer edges. The temperature necessary for melting was reduced with the depth, till at length there was not heat enough to melt further. The facts all tended to show that very little water would pass through a glacier by way of its surface. Some may pass over to the sides, and get beneath in that way, but the outer ledges of ice seemed to rest very firmly on the ground, as it necessarily must from its arch-like form, owing to the river beneath and the immense weight pressing on the edges of this arch; only occasionally can water be admitted that way, and scarcely could anywhere the volume so acquired be described as flowing from the side of the main glacier. What becomes of the melting snow on the snow-cap of the glacier, the continual and almost imperceptible meltings under the sun's influence at these heights? A prevailing impression is that glacier-ice is but snow which has become ice by the enormous pressure of so thick a body. If this be so, water thawed out from the snow by the sun's rays could not percolate far below the surface of the snow, and there seems no way left to account for the river beneath. If this be not so, then the way would be clear. With no ice below the snow, with the thermometer at the ground above the freezing-point, through the natural warmth of the earth protected by the snow-cap from escaping, the percolating water would descend to the surface of the mountain-top, part entering to furnish fountain-heads for springs and underground streams, running often hundreds of miles away, and the balance running down under the ice-channel formed by the glacier.

It seems such a fair assumption that this may be so, that it is worth while to consider the evidence offered for the belief that glacier-ice is snow under the pressure of its own weight. Snow has been artifically brought under pressure to ice, but such ice is not translucent, as is ordinary crystallized ice. The ice of the Alaska glaciers is remarkably clear, and, when in the proper position against the atmosphere, presents the most lovely cerulean tints imaginable. One of the speaker's pleasantest experiences was a wandering among the wrecks of icebergs strewn all along the shore, in Hoona or Bartlett Bay.[1]

No crystal could possibly be clearer than the fragments strewn everywhere along the beach. The only difference observed between this and the ordinary ice of every-day experience was that, melting in the mouth, it would divide into pieces of the size of peas before wholly uncongealed. Again, from the vessel

[1] At page 187, Proceedings of the Academy, 1883, Hood's Bay was inadvertently used for Hoona Bay. Hood's Bay is some hundred miles south of this point.

anchored a quarter of a mile from the face of the Muir glacier the portion to the southeast for a distance of perhaps a thousand feet, as examined by the field-glass, was of a different character to the rest of the face in having a milky white, marble-like look. The line of demarkation between this opaque and the transparent ice was exactly defined. It was not possible to get nearer for a more satisfactory examination, but the conclusion of all was that this portion was compressed snow. At this point the ice-sea had to draw in, through passing an intruding bluff of rocks, and the lateral pressure must have been enormous between the bluff and the solid ice. It would be the best possible opportunity for a mass of snow, carried down from the mountain side, and floated along on the margin of a wide glacier, to become ice if pressure would ever do it. It cannot, of course, be positively stated that this opaque section was compressed snow, in the absence of actual handling, but there is little room for doubt that it was. It was, at any rate, an opaque section, and wholly diffeıent from the glacier-ice as generally seen. Again, from the amount of air-cavities in snow, and the resistance these must offer to the self-pressure of snow, and also from actual experience of deep snow-drifts in ordinary mountain ranges, there is nothing to warrant a belief, outside of an actual demonstration, that the pressure of any depth of snow is of itself sufficient to turn it into glacier-ice.

If now we admit that above the glacial snow-line and under the great snow-cap there may not be solid ice formed by compression, but there may be a huge lake of water held back by the icy breast-work at the snow's edge, we may conceive of a method of forming the glacial sea quite different from any already proposed. The water must and will flow out from the edge of the snow-line when the temperature is far below freezing-point, and form a fringe of ice all along the line. How this is done can be readily seen passing under the snow-sheds of a mountain railroad.

On the Denver and Rio Grande Railroad, passing over Marshall's Pass, 14,000 feet altitude, as the speaker did in May of the present year, the melted snow passed as water through the mass to the bottom, then passed down the mountain-side under the snow to the snow-shed, where it formed real glaciers down the railroad—cutting under the sheds to the railway track. The law must of necessity be the same on a mountain-top in Alaska as on a mountain-top in the Rocky Mountain region. Snow occurring after this icy deposit was formed, would extend down the mountain over the ice, and new layers of ice would be continually forming over the old layers, or on their edges with the occasional retrocession of the snow. A portion of the water at the snow-head will naturally course under the ice, and form a channel beneath. This will increase in width and depth with time. In the torrent which sprung out from above the mouth of the Muir glacier myriads of stones, some of them of many cubic feet in size, were borne along by the muddy waters. The force of the water, as well as the added

force of the rolling stones against the roofs of the glaciers, must have some influence on its descent, as also would the weight of water under the snow forming the cap, pressing against it at the highest point of the glacial departure. The roof of the glacier above the torrent would possibly get worn away somewhat by the friction of the torrent; but as ice is now known to be ductile, it would bend down towards the water when any great hollowing out occurred, and get aid in its downward flow. We may further imagine that under such an explanation as this, the edges of the glacier would have much more of excoriating power, than when the whole mass is spread equally over a wide rocky bed.

In regard to the existence of the glaciers, Mr. Meehan observed that in many instances there were evidences of rapid retreat. Davidson's glacier, at the head of Pyramid Harbor, near the mouth of the Chilkat River, in about lat. 59°, had fallen back several miles from the water in the bay. Having but little more than half a day on shore at this point, an effort to reach the mouth of the glacier failed through taking a "short cut" through a forest of alder and spruce, the undergrowth of the spiny *Pana horrida* being almost impassable. But field-glass observation from the vessel, together with the examination of the track of the retreating ice, showed successive terraces of moraine material, with succeeding generations of trees on them in the supposed distance of three miles from the sea to the glacier's mouth. Near the glacier the trees appeared to be about twenty or twenty-five years old; nearer the sea, from seventy-five to one hundred. But here, as in the Muir glacier, there were evidences of frequent advances and of retrocession in the glacial material. Trees which from their size may have been from thirty to fifty years of age, would have a deposit of twenty or thirty feet of material placed around them, half burying them, and then again have it all cleared away, leaving the dead trunks to tell the story.

The volume of water now flowing in the line vacated by the glacier, is not near equal to the work which has been done in former times; and the less quantity with the retreat of the glacier itself, while other glaciers not fifty miles away still continue their connection with the water, shows that local causes may be at work which may either retard or accelerate a glacier's progress. As already noted, the warmth of the atmosphere near a glacier's mouth will, in a great measure, depend on the volume of cold water projected into the ocean—the greater the volume, the more influence on the warm current which must be drawn in to take its place; and this is as true of the atmosphere as of the water. The heavy cold body pushes the higher warmed air upwards, which has to take the place of the air which rolls forward towards the lightened spot. Hence the greater the volume of cold air departing, the larger and stronger the current of lighter and warmer air which returns to the source of motion, so the temperature is not low in the vicinity of the glaciers. On the iceberg before described, the

thermometer indicated 42° ; but a quarter of a mile from the immense body forming the mouth of the Muir glacier, the temperature was 60°. These warm currents, however, vary with the drafts through the mountains. Within comparatively short distances, the temperature would vary from between 40° and 60° at the time referred to. In the winter season the difference would be the more remarkable, and hence a mountain or glacier torrent, cutting out for itself a new channel, and making a deep rift in a mountain, would originate a new current—warmer or colder, as the case might be—which must have an influence on the progress or decrease of the glacier itself. The operations of these changes in the atmospheric currents were very evident in the vicinity of the Davidson glacier. Sometimes through chasms in the mountains near, the whole mass of timber on either side would be quite dead after having made a successful stand for from twenty-five to fifty years, by the work of some severe cold current, which, by some local change, had found its way along the course. Near by, on land no better, quite as steep, and in no way more favorable to the growth of vegetation, the timber would be perfectly healthy, the only difference being in the freedom from the atmospheric current that had destroyed the others. In short, the age of the trees on the successive terraces left by the waters along the line of the glacier's retreat, showed how much had been done within a comparatively recent period, and other attending facts showed that local causes, induced by the glacier itself, may rapidly retard or accelerate its development at various periods in its existence.

In the retreat of the glaciers, in this part of Alaska, an alder, *Alnus viridis*, was apparently the first arborescent plant to establish itself. Large tracts of the drift would be wholly covered by a dense, bushy growth. In time, however, many of these would advance to the dimensions of large timber-trees, surprising to those who might have only seen them as eight- or ten-feet bushes in other parts of the United States In the woods bordering on the Davidson glacier, the speaker saw Indians at work making canoes (dug-outs) from the trunks of this alder.

Favorable Influence of Climate on Vegetation in Alaska.—In his remarks on glaciers in Alaska, Mr. Thomas Meehan observed that on the tops of what are known as "totem-poles" in some of the Indian villages, trees of very large size would often be seen growing. These poles are thick logs of hemlock or spruce, set up before the doors of Indian lodges, carved all over with queer characters representing living creatures of every description, and which are supposed to be genealogies, or to tell of some famous event in the family history. They are not erected by Indians now, and it is difficult to get any connected accounts of what they really tell. At the old village of Kaigan there are numbers of poles erected, with no carving at all on them, among many which are wholly covered, and these all had one or more

trees of *Abies Sitkensis* growing on them. One tree must have been about twenty years old, and was half as tall as the pole on which it was growing. The pole may have been twenty feet high. The roots had descended the whole length of the poles, and had gone into the ground, from which the larger trees now derived nourishment. In one case, the root had grown so large as to split the thick pole on one side from the bottom to the top, and this root projected, along the whole length to the ground, about two inches beyond the outer circumference of the pole. Only in an atmosphere surcharged with moisture could a seed sprout on the top of a pole, twenty feet from the ground, and continue for years to grow almost or quite as well as if it were in the ground.

We may also understand by incidents like these how tree-life endured so very long in this part of Alaska, and why rocky acclivities, on which no vegetation at all could exist in the dry climate of the eastern States, were here clothed with a luxuriant fresh growth, so thick that it was almost impossible for one to make a journey through it. Indians had very few trails; most of their journeys were by canoes. At this village he also saw a bush of *Lonicera involucrata*, which was of immense size, as compared with what he had seen in Colorado and other places. This was at the back of an Indian lodge and alongside of a pathway, cut against the hill-side. The plant was growing on the bank and grew up some ten or twelve feet, where it bent over, apparently of its own accord, and rested on the roof of the lodge, its numerous branches making a dense arbor under which the road passed. The stems near the ground were, some of them, as thick as his arm, and the whole plant was covered by very large black berries. Stopping in admiration to look at and examine the specimen, brought numbers of Indians to see what was the subject, who smiled pleasantly on being made to understand that only the sight of a huge bush had attracted the traveler. Subsequently another specimen was noted in the woods on a plant of the native hemlock, *Abies Mertensiana*. In the woods the plant is somewhat sarmentaceous. It could not climb a hemlock without assistance. This old hemlock was bereft of branches to about twenty feet high, but the *Lonicera* was above the lower branches, and had journeyed along them to the extremities, beyond which it was beautifully in fruit. It could only have been there by growing up with the hemlock when that tree was young, and was probably of about the same age. The Indian village of Kaigan is not properly in Alaska, but just over the border in British Columbia, at the southeastern point of Alaska; but the climatic conditions are about the same.

The following was ordered to be printed:—